

Oxide and 4 pounds Titanox. Amounts can be varied according to density and covering capacity of enamel desired. For undercoats increase the amount of pigment to 10 pounds consisting of the following, 2 pounds Calcium Carbonate, 8 pounds Lithophone. All products must be bleached with Blue Pigment, by tinting.

Some slower drying, easier flowing architectural enamels are made simply by grinding.

ROOFING PAINTS.

Red Liquid Asbestos Coating.—

| | |
|--------------------------------------|------------|
| Pitch | 50 pounds |
| Naptha (49 degree) ... | 24 gallons |
| Aluminum Stearate ... | 2 pounds |
| Bright Red Oxide (Yellow tone) | 100 pounds |
| Fibrous Asbestos | 25 pounds |
| Blown Linseed Oil | 8 gallons |
| Kerosene | 4 gallons |
| V. M. & P. Naptha or Gasoline | 10 gallons |

This makes a batch of 52 gallons. Melt pitch in iron varnish pot until it is fluid. Remove from the fire and stir in one ingredient at a time in the order given in formula, very slowly.

Black Liquid Asbestos Coating.—

| | |
|------------------------------------|------------|
| Liquid Coal Tar | 50 gallons |
| Fibrous Asbestos | 40 pounds |
| Solvent Naptha (Straw Color) | 5 gallons |
| Blown Linseed Oil | 2 gallons |

This makes a batch amounting to 53 gallons. Liquid coal tar should be free from ammonia and water. If not put it in pot and slowly raise temperature to 250° F. and hold there until fumes are gone. Mix in the asbestos. **CAUTION.** Take away from the fire when mixing or adding Naptha or Gasoline.

DUST COLOR PAINT FOR FLOORS, ETC.

| |
|--------------------------------|
| 5 gallons Boiled Linseed Oil |
| 10 gallons Natural Gum Varnish |
| 5 gallons Japan Dryer |
| 5 gallons Turpentine |
| 3 gallons V. M. & P. Naptha |
| 100 pounds Zinc White in Oil |
| 100 pounds White Lead in Oil |
| 3 pounds Black Color No. 1 |
| 6 pounds Red Color No. 1 |
| 20 pounds Ochre Color No. 1 |
| 10 pounds Green Color No. 1 |

Formula for Colors.—

Black Color No. 1:

| | |
|----|---------------------------|
| 25 | gallons Lamp Black in Oil |
| 2½ | gallons Linseed Oil |
| ¼ | gallon V. M. & P. Naptha |
| 1 | pint Liquid Paint Drier |

Red Color No. 1:

| | |
|----|---------------------------------|
| 25 | pounds Red Oxide in Oil (light) |
| 3 | gallons Linseed Oil |
| ¼ | gallon V. M. & P. Naptha |
| 1 | pint Liquid Drier |

Ochre Color No. 1:

| | |
|----|------------------------------|
| 25 | pounds Ochre in Oil (French) |
| 4 | gallons Linseed Oil |
| ¼ | gallon V. M. & P. Naptha |
| 1 | pint Liquid Drier |

Green Color No. 1:

| | |
|----|-----------------------------------|
| 25 | pounds Medium Chrome Green in Oil |
| 5 | gallons raw Linseed Oil |
| ¼ | gallon V. M. & P. Naptha |
| 1 | pint Liquid Drier |

You can take a mixture of White Lead or Zinc as a base and by intermixing these various colors can get a paint with any desired shade.

To Get More Gloss and Body in Paints.—

By passing air through linseed and other oils what is known as Blown Oil is obtained. It appears to have more body but in reality this is false for it does not have. It does produce a paint with more gloss and one which will dry more rapidly and is being used very extensively today by leading paint manufacturers.

TOUCH UP BLACK.

The simplest way to make up a touch up Black is to purchase a high grade quality of clear outside coach varnish, one that will stand the weather fairly well. There are any number of varnish makers who will sell you very reasonably what you need.

If you get it in five gallon cans you can get a real good **FOUR HOUR Varnish** (dries in four hours) for around \$1.25 a gallon. To this you simply add from five to eight ounces of Carbon Black ground fine in Japan and stir it up and this will give you a touch up Black. This will dry quicker than four hours because the pigment causes the film to dry faster. It actually sets up in an hour so that in that amount of time it will be practically dust free. (We

mean to add from five to eight ounces on the Black to each gallon of varnish.)

TOP DRESSINGS.

There are two kinds particularly of dressings, Lacquer Type and Varnish Type. From these types hundreds of formulas originate, some good and some poor.

VARNISH TYPE DRESSING.

To a gallon of LONG OIL OUTSIDE SPAR Varnish add 6 ounces of Carbon Black, ground in Japan. Some finishers add a $\frac{1}{2}$ pint of linseed oil to this but if your varnish is long in oil enough you need not do this. The linseed or china wood oil gives the film more flexibility as does Castor Oil. Soya Bean and Fish Oil are also good especially the latter but it smells too much. The higher the gloss you want the less Black you add.

LACQUER TYPE DRESSING.

It's cheaper to buy a ready made Lacquer Solution than to make it yourself if you just are going to make up some top dressings. Get the following formulas: 10 ounces Cotton, 8 ounces Ester Gum in a gallon of 25% Butyl Acetate, 35% Butyl Alcohol, 40% Toluol. To this add 3 or $3\frac{1}{2}$ ounces finely ground Carbon Black. Then after you have added the Black and stirred it in with a gallon of Clear Lacquer, you add $\frac{1}{4}$ pint linseed or china wood oil to give the film flexibility. Castor Oil is sometimes used but is not so good for out door exposure.

COMMERCIAL PUTTY.

350 pounds Putty Whiting
450 pounds Marble Dust
12 $\frac{1}{2}$ gallons Putty Oil

Mix thoroughly in a putty chaser for large quantities. Putty Oil consists of 6 gallons Raw Linseed Oil, 11 gallons Paraffine Oil, $\frac{1}{2}$ gallon Japan Oil. This is similar to all well known cheap putties put out by large paint manufacturers.

OIL STAINS:

Early English Oil Stain.—

Oil Black ... 10 ounces
Oil Brown ... $\frac{1}{4}$ ounce
Oil Yellow ... 1 ounce
Linseed Oil
(Pure) 16 ounces (Liquid)
Turpentine .. 10 ounces "
Naphtha $\frac{1}{2}$ gallon

The turpentine is heated, preferably on a water bath, and the colors are dis-

solved. Then add the linseed oil and when it is cooled off the naphtha is added. Be very careful to avoid a fire when heating the turpentine.

Antwerp Oil Stain.—

Oil Black 2 ounces
Oil Yellow 2 drams
Oil Red 37 grains
Linseed Oil ... 17 liquid ounces
Turpentine 17 liquid ounces
Naphtha $\frac{1}{2}$ gallon

Prepare in the same manner as directions given above.

Fumed Oak Oil Stain.—

Oil Brown 15 ounces
Oil Black $\frac{1}{2}$ ounce
Oil Mahogany $\frac{1}{8}$ ounce
Benzol $\frac{1}{2}$ pint
Acetone $\frac{1}{4}$ ounce

WATER STAINS.

There are three classes of stains most commonly used, Oil, Water and Spirit. While Oil Stains are used greatly by the painters and decorators, Water Stains are used almost entirely by furniture and other manufacturers of products requiring stains. It will not be out of place to list a few Water Stains. Water soluble colors are of course used in Water Stains.

Mahogany Stain-Water.—

Brown Mahogany 7 ounces
Red Mahogany 4 ounces
Water 1 $\frac{1}{4}$ gallons

Adam Brown Mahogany.—

Brown Mahogany 1 ounce
Jet Black Nigrosine..... $\frac{1}{4}$ ounce
Bichromate of Potash... $\frac{1}{8}$ ounce

Antique Mahogany.—

Mahogany Brown 1 ounce
Mahogany Red $\frac{1}{2}$ ounce
Potassium Bichromate .. $\frac{1}{4}$ ounce
Water 2 quarts

There are numerous antique mahoganies. The wood in this case is usually filled with a very dark paste filler and two coats of the stain are applied in the regular manner.

Mahogany Water Stain for Birch.—

Brown Mahogany 2 ounces
Red Mahogany 3 ounces
Water 3 quarts

Usually the wood is first sponged with a weak lye solution, sanded, stained, shelaced and varnished.

NEW DISCOVERIES IN PHOTOGRAPHY

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DEFECTS IN PHOTOGRAPHIC WORK:

The professional, as well as the amateur, sometimes have noticed that during their work, certain photographic defects make their appearance. It is sometimes hard to ascertain the course of these defects. We have therefore prepared a very simple system of analysis, for example:

Different Kinds of Stains.—A whitish, powdery scum which appears on the negative after fixing, may be a precipitation of hypo, and can be removed simply by rewashing the negative very carefully. If this does not remove it, it is probably a precipitation of aluminum sulphite sludge in the use of an alum-acid fixing in which the alkaline developer carried into the bath has neutralized the acid content. This can usually be removed by soaking the plate or film in a 5 per cent bath of sodium carbonate and washing thoroughly. Should the temperature be above 65° F., it is best to harden the film first in a 3 per cent solution of formalin and then wash it before using the sodium carbonate bath.

Yellowish White Opalescence.—This gives the negative an appearance of being made on white celluloid or opal glass. This may be the result of a warm hypo bath, or a bath containing too little sulphite, or too much acid. A fresh sulphur stain of this kind can be removed by first soaking the negative in a 5 per cent solution of a formalin to harden the film, for 2 or 3 minutes, then by washing it thoroughly and soaking in a 10 per cent solution of sodium sulphite at a temperature of 100° to 120° F.

Silvery White Opalescence.—This is sometimes a result of a negative which is dried by means of denatured alcohol with the aid of a heat, and is usually removed very easily by rewashing the negative with water and drying it at a normal temperature. The same method will remove the opalescence if it is caused too strong a hypo or acid content in a fixing bath. If stains are due to the presence of iron particles in the fixing bath, indelible pencil marks, aniline dyes, etc., they are best removed by bleaching the negative first, and then redeveloping it by any of the methods described on these pages.

How to Remove Hypo from a Negative.—It is most important that the film, after the development, should be perfectly free from any trace of hypo. The best way to insure this is to apply a weak solution of potassium permanganate to the film repeatedly. In order to prepare a sufficient volume of permanganate solution, dissolve 8 grains of potassium permanganate in 128 ounces of water. After fixing and rinsing the negative, soak it in a few ounces of permanganate solution. When the pinkish color disappears, this will show the presence of hypo in the film. The faded solution should be poured off, and fresh solution should be poured over the negative. This method should be repeated about six times, or until the permanganate solution no longer loses its pink color, which will prove that no trace of hypo remains in the film. The way to obtain the best results with this method, is to use a weak solution as given above, and to change the solution in use quickly. If you allow the negative to remain in a faded solution, brown stains will usually

appear. That is why this method necessitates the frequent and quick changes during the removal of the hypo. The six washings advised should not take more than ten minutes.

How to Remove Permanganate Stains.—Stains resulting from undissolved permanganate crystals in the negative film can be removed by soaking the negative for a few minutes in the following solution: Water 20 ounces; glacial acetic acid, $\frac{1}{2}$ ounce; sulphite of soda (cryst), $\frac{1}{4}$ ounce. When the stain has disappeared, wash the negative well and dry.

Spots in Negatives.—This has many causes. The best way to remedy this is to eliminate the cause. Spots can be taken out with the point of an etching knife, or can be "spotted" with a touch of color on the tip of a brush. Although this will eliminate these spots, it is best to prevent them entirely.

Spots Which are Clear and Transparent.—These spots are sharply defined and irregular in shape, and are caused by dust which is on the surface of the film during its exposure. Dark spots are caused by dust particles in the film, usually particles of black enamel or metal from the metal sheaths in which cut films and plates are carried. Both varieties are usually found in negatives made on plates and films which are carried on motor and cycling trips. When working under such conditions, the best way to keep the camera, sheaths, holders, and magazines free from dust, is to use a slightly dampened or chemically prepared dustless cloth very carefully, before filling the holders or putting in a new film spool.

Spots of Angular Shape.—These are caused by scum which sometimes forms on the surface of the developing solution. When this is disturbed, it breaks up into small angular particles, which cling to the film, causing the spots described.

Small Transparent Holes.—These are circular in shape with a clearly defined outline, and are due to air-pockets which have remained on the film during the development. If they are removed during the course of development, they usually leave their impressions, not very clearly outlined but requiring attention in preparing the negative for printing. These air-pockets are caused by diluting the developing solution with tap water, too actively rocking the tray, or the

unskillful immersion of plates in a tank. It is advisable to keep a bottle of boiled water at hand for diluting developing solutions, and to lightly swab the film surface with a wet pad of cotton-wool right after immersing the plate or film in the developer. If air-pockets remain throughout the development and fixation, there is usually a little opaque center to the transparent spot, which is due to undissolved silver bromide. Lift this out with the knife and fill the hole with color matching the rest of the negative.

Small Dark Spots.—These are often due to particles of chemical dust or dry developer falling on the film during development, or to undissolved particles of the developer in the developing solution. This will usually happen when the developing agent is added "dry" just before use, as in the case of pyro and amidol developers. The sludge found in developing solutions after repeated use, sometimes gives rise to dark spots in the negative, as iron rust will from water supply pipes. If you use care and cleanliness in the use of solutions, trays and in mixing developers in the dark room, you will without a doubt prevent such troubles.

Yellow or Brown Spots.—These are caused by air-pockets forming on the film during fixation, and can usually be removed by refixing the plate or film in a freshly prepared fixing bath. A plate, badly blotched, should be immersed in a clearing bath composed of 1 ounce of sulphuric acid in 20 ounces of water, for a few minutes only; this will completely remove the dark spots.

Minute Dark Streaks.—These streaks near the edge of the plate usually indicate the leakage of light from some point quite close to the plate or film in the camera back, or the slot into which the holder is fitted, or in the slide fitting of the holder itself. Usually the streaks are scattered in a band of fog and clearly show the direction of the light leakage. The defective point can be ascertained upon careful examination.

Fine Scratches or Lines.—These lines running from end to end of a rollfilm or film-pack negatives are caused by dust particles or fine sand clinging to the roller over which the film is wound after exposure. There is, of course, no remedy. This condition is often found in negatives made at the sea shore, and occur more often in film-pack than rollfilm negatives.

Fog.—Fog is a more or less dense veiling or deposit over the negative image, which is easily distinguished from the less severe veiling or flattening of the contrasts in the negative resulting from over-exposure and under-development, may be general or local, and be due to light or chemical action.

Diffused Light Fog.—This fog or veil which covers the whole negative and which is fairly even in density, may be caused by dust or moisture on the lens scattering the light passed by the lens; reflections from the camera bellows when a large aperture lens of greater covering power than is required by the plate is used; light glare from the use of a large aperture lens with little or no front flange or hood protection in a strong light; pinholes or minute breaks in the bellows of the camera or light leaking into the camera through an ill-fitting front board or lens flange, or at the space between the camera back and the plateholder or filmpack adapter or the back cover of a rollfilm camera. If the fog is centered on the plate or film in the form of a vignetted disk, this may be the result of an imperfectly closing shutter resulting from dust between the shutter leaves plus strong direct light. A circular patch of fog, due to lens flare, sometimes appear in negatives made against the light, as in an interior where the lens faces dark detail between two windows. If using a lens hood does not eliminate this fault, the lens should be returned to the maker for examination. General light fog as above described, due to light leakage in the camera, is clearly shown by the edges of the plate or film, protected by the rebate of the holder or sheath, remaining clear and free from the defect in development.

Local and Direct Fog.—This fog is very often so dense that it blots out the image where it strikes the plate. This usually comes from light leaking through a hole or defect in the plate box or film package, from defective plateholders or filmpack cases, or from rough handling of filmpacks or carelessness in loading the film in the camera in bright light or preparing the film for development. In the last two instances, the light creeps in at the edges of the film, and the direction of the fog streak plainly shows its origin. When the fog patch begins at the lower edge of the negative and spreads with decreasing density, this shows that light reached the film when the slide of the plate

holder was roughly withdrawn or reinserted after exposure, the velveted light-stop being forced apart by the twist given to the slide. Similarly a sharply defined light patch on a plate negative indicates a small hole or crack in the holder slide. Giving an "instantaneous" exposure with the shutter set at "time" or "bulb"; using a much larger lens aperture instead of the small aperture for which the exposure was calculated; and exposing the film to strong light between development and fixing, are other causes of general light fog.

Chemical Fog.—This fog is a thick veil which covers the whole plate or film, setting in during development, and may be due to many causes; such as metal magazines or holders varnished with a substance containing turpentine or other destructive varnishes; an unsafe dark-room light, due to the leakage of white light in the room while the plates or films are being loaded or developed, or dye which has faded; the use of a developer at too high a temperature in development, or a developer containing caustic or other alkali in excess, or too large an amount of sodium sulphite in the developer, or the mixing of the developing solution while the plate is being developed, or the contamination of the developing solution with hypo or from old or cracked or unclean trays. Plates and films which have been stored in a warm, damp basement, are subject to various gases which are very liable to show chemical fog, in development.

Troubles Resulting from Hot Weather.—Faults such as frilling, reticulation, graining, mottling, the softening or actual running of the film, or the sudden appearance of a crop of minute blisters, are difficult to remedy, but they can be easily avoided by a little thought and care in negative making during the summer months or under tropical conditions.

Frilling.—This is the separation of small areas of the film from its supporting base, almost always at the edges of the picture image. Some plates are more prone to this fault than others, but most plates will frill in very hot weather if carelessly handled with warm fingers, or if subjected to long immersion in a warm solution and then transferred to a much colder solution, or transferred from a strongly alkaline developer to a cold acid fixing bath, or if left to wash under a tap so that the water strikes it edgewise. To prevent frilling, avoid working in a warm darkroom,

avoid prolonged development and the use of developing solutions strongly alkaline or made up with a caustic alkali, see that the developing solutions, hardener, fixing baths and wash waters are all about the same temperature, not over 60 F. In cases where you may be skeptical, use an amidol developer thus avoiding the use of alkali in the development altogether, or if an alkaline developer is used, employ a strong solution and shorten the time of development accordingly. Do not touch the surface of the film with your fingers. It is always advisable to use a hardening bath between development and fixing, in hot weather. Such a bath is made up of 1 ounce of potassium chrome alum dissolved in 32 ounces of water. If this alum bath gives rise to mottled, leathery markings in the film, substitute a bath made up of 1 ounce of formalin in 20 ounces of water. Give the plate, in either case, a short rinse after development, soak it in the hardening bath for three minutes, again rinsing it before placing it in the acid fixing bath—which is always preferable to a plain fixing bath in hot weather.

Mottling.—The appearance of irregular shaped patches, lighter in density than the rest of the film, is more apt to appear in hot weather development than at other seasons. This is caused by the failure to keep the developer moving over the whole film, or by adding new developer or dry pyro to the working solution in the tray during development.

Reticulation.—Graining of the film is caused by transferring the plate or film from a cool solution, or a hardener, to a warm solution, as in washing the plate in water warmer than the fixing bath. Too much washing, or the use of too rapid a stream of water in a warm dark-room will sometimes cause this trouble.

Blistering.—Covering the image with a network of minute blisters, comes from the same causes outlined above, and is often a result of putting the plate to dry without first wiping the surface with a semi-dry swab of cotton-wool, to remove some of the over-abundant wetness of the film.

The Fixing Bath.—This needs careful attention in the summertime, and should be renewed quickly as soon as it appears to be weakening, which can be ascertained by its slow action. A weak fixing bath causes many troubles; mottling, uneven density patches, brown markings, and etc. Do not try to strengthen

an old fixing bath by adding fresh hypo. Make up a fresh bath. A good acid fixing bath for the summer is made up as follows: Mix in the order given. Water, 100 ounces; sulphuric acid, 3 drams (added a few drops at a time); sodium sulphite (cryst.), 4 ounces. When thoroughly dissolved, add chrome alum 2 ounces, previously dissolved in 20 ounces of water. Finally make the bulk of the bath up to 160 ounces by adding water. Let the negative remain in this fixing bath fully 15 minutes after the film is completely cleared.

Double Exposures.—Sometimes one is surprised to find two separate and distinct picture images on the same plate or film; a house with a boat sailing serenely across it; a bridge with a house right in the middle of it. This mistake was simply caused when you forgot to change the plate by reversing the holder if double plateholders are in use, or did not put in a new holder if single holders are used; or forget to pull a new plate or film into position if you use a filmpack, or neglected to wind a new film into position if you use a roll-film camera. One is very apt to overlook this vital detail when one's attention is distracted right after an exposure.

The Remedy.—In the case of the roll-film camera, just get into the habit of winding a new film into position right after each exposure or, when using the filmpack in the camera, pull a new film into position immediately after an exposure and before replacing the adapter slide which protects the film. In the case of plates, whether in single or double holders, the best way of avoiding this failure is to make one side of the holder slide with the word "exposed," and to replace the slide after exposure with this notice on the outside. A few plateholders have an automatic catch where the side is withdrawn, and which locks the exposed plate, when the slide is replaced after exposure. The average holder, however, does not have a device of this sort.

The Blank.—This is a failure which gives no trace of a picture image, resulting in a blank plate or film. This may be due to several causes. If we are using plates, we may have neglected to draw the slide of the plateholder; or we may have used a backed plate and put the plate into the holder with the backed side facing the lens; or if we are using a magazine plate camera, the sheath

carrying the plate may have dropped into the well of the base before exposure, in which case we will probably have a double exposure on the next following plate in the series. If we are using a film-pack, we may have pulled two tabs, and so put an exposed plate in the back ready for development before exposing. If it is a rollfilm camera with an unexposed section of film ready for exposure, a rewinding just before exposure will have the same result. The only time to wind a new section of film ready for exposure is after each succeeding exposure has been made. Whether plates or films are in use the failure of the shutter to open will give us a blank plate or film, which failure may be due to the mechanism of the shutter or lack of action in the release. Finally, a developer compounded without some essential chemical, such as an alkali or the developing agent itself, will give us a blank.

To Err is Human.—Think first before you work. Plan your work. Never run until you get on the right road because you may have to go back a long way.

DEVELOPERS

PHOTOGRAPHIC DEVELOPING:

Developing is perhaps the most important as well as the most interesting part of photography.

Professor Einstein once stated that it is more valuable and more important to know "WHY" you put the various ingredients in a pot than to just know "HOW" to put them in; and it is true, for when one knows "WHY" they are put in, he then has the controlling factor in his hand, and can, at will, change the formulas with perfect safety to suit any particular or unusual experiment.

It is for this reason that we first explain "why" all the ingredients are needed for developing, and what their respective or combined actions are.

When a film is exposed to an object through the lens of a camera, some action takes place on the surface of the film. The action is very minute and cannot be seen by the naked eye or even through a microscope, for the image "taken up" by the silvers in the emulsion is invisible, and is photographically termed the "latent image." This latent image is brought into visibility by certain chemicals in solution. The chemicals are divided into four classes, namely: first, the "Pioneer" (alkali); second, the "Reducer" (the developing agent); third, the

"Restrainer" (bromides); fourth, the "Preserver" (sulphites).

The exposure of the film to light merely starts what is called a primary "reduction" which is invisible, as has been stated, and this action started by the light must be carried on and completed by the chemicals in the developing solution to form a visible image of black silver.

The "Pioneer" is the alkali which may come in the form of sodium carbonate or a similar salt. The alkali precedes the actions of the other chemicals in the solution and attacks the gelatin that embodies the silver halides (the light sensitive silver salts). It causes the gelatin to soften and swell, enabling the developing agents to penetrate to the silver halide particles embedded in the gelatine. These developing agents are salts in the solution that have the power to force the silver to break its bond with the halide and become metallic silver. This change is termed "reduction." Developing agents affect all silver halide particles alike, whether they are partially reduced by light or not, and tend to reduce them all to metallic silver. To prevent this, a restrainer, (a bromide salt) is added. This salt makes the developer sensitive to just the silver halides in the image.

It is well to remember that a reducing agent will attack all the silver halides in the emulsion and cause them to blacken without regard for the latent image already formed by the light through the camera lens. To make the reducing agent selective, that is to limit its action to only those silver halides in the latent image, a restraining chemical is mixed with the solution. The restrainer slows up the reducing action of the developing agent and gives the photographer opportunity to control the developing to a certain extent.

There are a large number of salts capable of reducing silver salts but they cannot all be used because they cannot be made selective nor the speed of reduction be controlled. Of the reducing agents that can be controlled and made selective, the most commonly used are pyro, hydroquinone, metol, and amidol. They all combine readily with oxygen, but as they are fairly neutral salts, they will not act except in an alkaline solution. Thus, we see that the alkali in the developer has two distinct actions, viz., softening the gelatin, and furnishing the alkalinity so that the reducing agents might combine with oxygen and reduce

the silver halides. The most common alkali in developing formulas is sodium carbonate. Potassium carbonate is sometimes used, and for extreme contrast and harsher effects sodium hydroxide is used. For finer grain, such as is necessary for motion picture and miniature camera work, a milder alkali is used. This is generally sodium borate.

A strong alkali or an excess tends to speed up the action of the reducing agent to such an extent that it is necessary to add more restrainer to prevent the total reduction known as "fog." These restrainers are most generally ammonium or potassium bromides, but sometimes a chromium salt is used by experimenters. These restrainers increase the selectivity of the developer and at the same time larger amounts of alkali may be added to further increase the speed of the developer.

We now understand that a developing solution must contain a "reducer," and an alkaline agent to permit its action by softening the gelatin. Then, too, it must contain a restraining agent which protects the unaffected silver halides from reducing or blackening.

There is, however, another important point in developers that we must not overlook. All the above mentioned ingredients in the developers would last but a few hours in solution unless a "preserver" was added. All the reducing agents have an affinity for the oxygen of the air, which becomes dissolved in the water, and thus oxidation takes place, the solution becomes discolored, and all the prints or negatives developed in such a solution are stained and ruined.

Sodium Sulphite has even a greater affinity for oxygen than any of the other ingredients in developers, and yet it is used as a preserver. It acts as a preserver by taking the oxygen from the solution and forming sodium sulphate, thereby protecting the solution from deterioration but at the same time taking no part at all in the chemical action of developing. There are other preserving agents used in developing solutions in place of sodium sulphite, these being, generally, bisulphites or metabisulphites of potassium or sodium.

We have mentioned all these things to teach you why the various ingredients are used in developers, and when you are reading over the formulas given for developers, you will readily understand why the various chemicals are used and what their respective actions and effects will

be. Before entering into the formulas, here is a "trouble chart" that will enable you to locate the causes of your troubles in defective developing.

TROUBLE CHART:

Fogging.—Caused by accidental exposure of the paper or film to actinic light; or, deterioration of the paper or film through age (look for the expiration date on the box); or, insufficient bromide in the developer; or, too much carbonate in the developer, thus causing an over-reduction of the silver salts (the addition of more bromide will overcome this); or, impure chemicals (always buy chemicals that are prepared especially for photographic use; or, improper mixing of the chemicals in the solution. Be sure you add the chemicals in the order in which they are given in the formula. The use of warm water aids in dissolving the chemicals, but heat accelerates their decomposition and it must be remembered that no formula should be mixed with water warmer than 125° F. unless otherwise specified in the formula.

Discolored Developing Solutions.—Insufficient sulphite to prevent oxidation; or, too much carbonate, impurity of ingredients, water too hot when mixing, water containing iron salts in solution, or chemicals added in the wrong order when mixing.

White Sediment Forming in Developer.—The most common cause for this trouble is the adding of too much sulphite before the metol (Elon or Pictol) is dissolved. Metol will not dissolve in a sulphite solution but will form an insoluble white compound known as methyl-aminophenol which precipitates upon standing. For this reason, always dissolve metol first and be sure it is all dissolved before adding the sulphite. It is a good practice to stir the solution until you are certain the last chemical added is completely dissolved before adding another.

Crystallizing.—One can always get more solid matter to dissolve in a warm solution than in a cold one and often a solution that was near its saturation point while warm will surpass it upon cooling and will be filled with crystals. Often stock solutions are made so near saturation and when stored in a cold place will crystallize. The addition of about 10 per cent of ethyl alcohol will prevent this and will not impair the efficiency of the solution.

Frilling and Blistering.—This is generally caused either by the excess of alkali in the developer, or the high temperature of the solutions through which the films pass. If you are in hot climate, it is advisable to use the "Tropical Developer, formula D.13." Another method is to treat the films, papers, and plates with an 8 per cent solution of formalin for 2 or 3 minutes before putting into the developer. Of course, this must be done in a darkroom. In the case of too much or too strong an alkali, it is best to mix proper solutions and discard the old. The developing solutions should never exceed 73° F. while in use.

Improper Mixing.—The chemicals should be mixed in the order stated in the formula as has been stated before, but as this is of such signal importance, it bears repeating. Also they should not be mixed in water warmer than 125° F. unless the formula specifies it. The preserver must always be added before the alkali. If this is not done the alkali attacks and decomposes the developing agent and renders the solution useless.

FINE GRAIN DEVELOPING:

Fine grain developing is an important factor of the present day camera. Enlargements made from small films will show "grain" and coarseness unless the films are developed in fine grain developer.

A photographic film consists essentially of an emulsion of silver bromide, and silver bromide is made by adding potassium bromide to silver nitrate. Iodide mixed with silver makes silver iodide, chloride with silver makes silver chloride, and so on, all down the line. The silver bromide particles are the sensitive agents in photographic films, just as silver chloride is the sensitive agent in our printing paper. These bromide particles are encased in gelatine walls (just like honey is encased in beeswax). These little cells are like thousands and thousands of small mirrors packed closely together. They resemble mirrors in many ways, for both have silver nitrate as their medium of light absorption. When the film is exposed to light in a camera, the lens acts somewhat like a telescope or pair of field glasses does to the human eye. It condenses the picture, the light strikes the bromide cells and as far as the action of the camera is concerned, it is finished. The next step is developing the film.

The action of the developer on the film simply removes the bromide from the silver, and at the same time converts the remaining silver into "black metallic silver" which forms the image that the camera has "taken." This image, of course, is made up of grains, because the original emulsion consisted of microscopic crystal cells.

When the action of the developer removes the bromide from these cells, the cells break up, due to the water in the developer, causing the gelatine to absorb water and become soft. Thus, the silver bromide is fully exposed to the action of the developer, and the so-called reduction of the silver takes place. Now it is at this point that the present day FINE GRAIN developers play their important role.

The action of the developer in causing the casing of gelatine that had previously enclosed the silvers to break down, allows the silvers, minus their bromide, to become "wild." As they have a magnetic attraction for each other, they build up in CLUMPS in the craters of what were gelatine cells (or crystalline shells that encased the original silver bromide microscopic grains).

These craters are brought about by the so-called "boiling action" of the encased silvers.

This "boiling action," or eruption, of the encased silvers in their dried crystal gelatine cells, takes place due to two things; the action of the light on the cells when the film was exposed in the camera, and the action of the developer.

The action of light with which we are chiefly concerned at this present moment is a photo chemical action resulting in the decomposition of the compounds (the silvers), to be followed later with a chemical action of the developer.

It is well known that under the influence of light such elements as sulphur and phosphorus gradually become transformed into their so-called "allotropic" modifications, ordinary phosphorus becoming red, or amorphous, and a strong solution of sulphur in carbon di sulphide slowly depositing the insoluble modification when exposed to sunlight in a sealed tube. So also certain metallic salts, such as the crystalline chloride iodide or bromide of silver, nickel sulphate and zinc selenate, experience a change in crystalline form under the influence of light. Regarded as a chemical agent, light may produce both combination and decomposition, although it is often very difficult

to say whether any particular effect is the result of one or the other or of both modes of action. Consider for instance one of the most familiar cases, that of the action of light upon a mixture of chlorine and hydrogen. These gases, as is well known, react explosively under the influence of a strong light to form hydrogen chloride.

We have explained this to enable you to understand that light action plays a very important part, not only in the "taking" of photographs, but also in bringing the latent image into visibility during the developing.

Once the water in the developer softens the gelatine cell casing surrounding the microscopic silver grain, the alkali in the developer causes the gelatine to soften to a further point; and it is for this reason, alkalies such as sodium carbonate, etc., should be very sparingly used in fine grain developers.

We understand (as mentioned previously) that it is the "clumping" of the "wild silvers" that cause the coarse enlargements or movies. The magnetic attraction that the silvers have for themselves causes them to bunch together in certain cells, thus leaving certain craters empty, and it is because of this uneven distribution that a 10 or 15 diameter enlargement from such a negative shows a mottled, blotchy, appearance that is termed to be "grainy."

This is very easily understood, for in each erupted cell there is only one microscopic grain of silver, and if the magnetic attraction of certain silver grains causes others to leave their craters, empty spaces must result. And where a "bunch" of silver crystals have clumped together another defect, "dark spots," will be noticed. Where the craters are empty "light spots" will appear. These varied actions make the finished photo "blotchy."

EXPOSURE:

Over exposed pictures, (that is, films that have been over-timed) increase the amount of light energy absorbed by the silver bromides. This makes developing action more rapid, with the result that the eruption of the encased silver bromides are greatly accentuated, causing the gelatine casings to break down more rapidly. This, in turn, allows the silver to become "wild," and then to "clump" together.

A developing chemical with a high reduction potential, such as metol, and ordinary developers that are used for

the ordinary contact plates, reduces silver bromides very quickly, rendering them unsatisfactory for fine grain developing and they should NOT be used.

Physical development which produces a very even grain consists essentially of the reduction of the silvers in the developer without the breaking down of the gelatine cells and preventing the silvers from becoming wild. So in fine grain developers, we must use none or very little alkali, so as to prevent as far as possible the complete collapse of gelatine cells; and we must observe the temperature of our developer perhaps a little more than we do in the usual old time developers.

Warm water, alone, will cause the cells to break down rapidly and will cause the gelatine not only to collapse, but also to swell and cause the film to "frill" or check; too much alkali will also cause this. Fine grain developers have a very inconvenient point and that is the length of time required to bring about this fine grain, even development. The temperature of the developing solution determines the length of developing time. For instance, a fine grain developer used at 75°, requires 25 minutes developing time; whereas the same developer, used at a temperature of 65° requires 30 minutes developing time.

It is well to know, however, that if one purchases fine grain emulsion films, such as Eastman's Panatomic and DuPont's micropan only approximately half the above time is required to yield good results.

DEVELOPERS:

Fine Grain Developer for Miniature Films.—Paraphenylene diamine is one of the best fine grain developers we have today. This product has been used by the fur trade as a fur dye for many years, but the grade used in the fur business is not pure enough for fine results and it is recommended that the better grade be purchased from a photographic supply company. The low grade paraphenylene diamine can easily be detected by the fact that it usually contains black lumps and is purplish, whereas the better grade is free from lumps and is of a lavender hue.

| | |
|------------------------|------------|
| Paraphenylene diamine | 305 grains |
| Photographic glycin .. | 92 grains |
| Sodium sulphite | |
| (anhydrous) | 3 ounces |
| Distilled water | 32 ounces |

Requires no dilution. Develop for 25 minutes at 70° F. or 30 minutes at 65° F. Fine grain films take about one half the above time.

Here is another good formula, but when first mixed is very sluggish in action. It should stand for at least 8 weeks before using.

| | |
|-----------------------------|------------|
| Paraphenylene diamine | 152 grains |
| Metol (elon or pictol) | 70 grains |
| Sodium sulphite (anhydrous) | 2 ounces |
| Trisodium phosphate | 50 grains |
| Potassium bromide | 16 grains |
| Water, distilled | 32 ounces |

Develop for seven minutes at a temperature of 65° F. This yields soft negatives that will enlarge to approximately 45 diameters. The preceding formula will enlarge even more.

Borax developer for fine grain work is widely used and gives very good results that will enlarge 80 diameters without noticeable graininess. Thirty-five millimeter film negatives developed in this may be enlarged to 5x7 inches satisfactorily.

| | |
|------------------------------|------------|
| Metol | 116 grains |
| Sodium sulphite (desiccated) | 13¼ ounces |
| Hydroquinone | 290 grains |
| Borax | 116 grains |
| Water | 128 ounces |

Dissolve the metol in a small quantity of water at 125° F. and pour into the tank. Dissolve about one fourth the quantity of sulphite in water at 140° F. and stir in the hydroquinone until it is all dissolved and the solution is clear, when it too may be poured into the tank. Dissolve the remainder of the sulphite and the borax in water of 140° F. and pour into the tank. If this does not make up the quantity of water necessary, add cold water to make up the deficiency. Cool to 65° F. for use and develop 15 to 20 minutes.

Motion Picture Film Developer.— Negative or positive film.

| | |
|-------------------------------|------------|
| Water (125° F.) | 16 ounces |
| Metol (elon or pictol) | 17 grains |
| Sodium sulphite (desiccated) | 5¼ ounces |
| Hydroquinone | 350 grains |
| Sodium carbonate (desiccated) | 2½ ounces |
| Potassium bromide | 50 grains |
| Potassium metabisulphite | 85 grains |
| Cold water to make | 1 gallon |

Develop 10 to 15 minutes at a temperature of 65° F.

Motion Picture Developer for Negatives.—

| | |
|-------------------------------|------------|
| Water (125° F.) | 16 ounces |
| Metol (elon or pictol) | 115 grains |
| Sodium sulphite (desiccated) | 2½ ounces |
| Hydroquinone | 29 grains |
| Sodium carbonate (desiccated) | 1¾ ounces |
| Potassium bromide | 43 grains |
| Cold water to make | 1 gallon |

Develop 6 to 12 minutes at a temperature of 65° F.

Developer for X-ray Films.—

| | |
|-------------------------------|-----------|
| Water (125° F.) | 16 ounces |
| Metol (elon or pictol) | 35 grains |
| Sodium sulphite (desiccated) | 3½ ounces |
| Sodium carbonate (desiccated) | 1¾ ounces |
| Potassium bromide | 90 grains |
| Cold water to make | 32 ounces |

Do not dilute. Develop 5 minutes at 65° F.

Tropical Developer.—

Great trouble is experienced by the photographer in tropical climates and by those who operate in small badly ventilated darkrooms due to the heat which causes frilling, blistering, and reticulation. The simplest way to prevent this is to place the developing and fixing trays in larger trays filled with cracked ice. But ice cannot always be obtained in the tropics and it is necessary to adopt other means. Motion picture companies have overcome their troubles to a great extent by using the following developer.

| | |
|-------------------------------|------------|
| Water | 32 ounces |
| Para-aminophenol oxalate | 75 grains |
| Sodium sulphite (desiccated) | 1¾ ounces |
| Hydroquinone | 150 grains |
| Sodium carbonate (desiccated) | 1¾ ounces |
| Potassium iodide | 30 grains |
| Sodium sulphate (crystals) | 3½ ounces |

Requires no dilution. Develop from 5 to 8 minutes at a temperature not greater than 90° F. At a lower temperature the developing time is slightly longer. Fix in a hardening hypo bath (see Fixers). After washing, immerse

the negatives in a solution of 1 part formalin and 16 parts of water for a period of ten minutes. Rinse in water and allow to dry.

Developer for Copying and Process Negatives.—All copying should be done using a small "stop" or lens aperture to increase the sharpness of detail in the negative. Of course, using a small stop means increasing the exposure, but this is necessary to insure best results unless the lens has an exceptionally flat field, in which case the lens can be used at full aperture with no danger of soft focus and loss of detail at the edges of the plate. The following formula gives exceptional contrast for line and process negatives.

| | | |
|-------------------------------|----|--------|
| Water (125° F.) | 35 | ounces |
| Metol (elton or pictol) | 7½ | grains |
| Sodium sulphite (anhydrous) | 1¾ | ounces |
| Hydroquinone | 75 | grains |
| Sodium carbonate (desiccated) | 3½ | ounces |
| Potassium bromide | 15 | grains |
| Common table salt | 15 | grains |

Develop 6 minutes at a temperature of 65° F. Dilute 1 part to 2 parts of water.

Contrast Developer (Jet black tones) Formula (D-29).—Here is a developer that combines the Pyro with the present day Metol and is suitable for fine line or process work (2 solutions).

| | | |
|------------------------------------|----------------|--------|
| A.—Water | | |
| (125° F.) | 64 | ounces |
| Elton or metol | 140 | grains |
| Sodium sulphite (any) | 4 | ounces |
| Hydroquinone | 1 ounce and 85 | grains |
| Sodium carbonate (any) | 8 | ounces |
| Cold water to make one gallon. | | |
| Add and mix in the rotation given. | | |

| | | |
|-----------------------------|----|---------|
| B.—Sodium bisulphite | | |
| | 75 | grains |
| Pyro | 1 | ounce |
| Potassium bromide | 20 | grains |
| Water to make | 32 | ounces. |

Use four parts of "A" and one part of "B" at 65° F. Develop about 2½ to 3½ minutes.

Universal Developer Formula (D-72).—This formula is about the most accepted universal present day developer, and is called the (D-72). It is sold by all Eastman stores.

| | | |
|------------------------|-----|--------|
| Water (125° F.) | 16 | ounces |
| Elton or metol | 45 | grains |
| Sodium sulphite (any) | 1½ | ounces |
| Hydroquinone | 175 | grains |
| Sodium carbonate (any) | 2¼ | ounces |
| Potassium bromide | 27 | grains |
| Cold water to make | 32 | ounces |

For chloride contact paper, dilute 1 part to 2 parts water. 1 part to 4 parts water for bromide papers and 1 part to 3 parts of water for plates and films.

Tank Developer D-75.—

| | | |
|-------------------------------|-----|--------|
| 1. Water (125° F.) | 16 | ounces |
| Metol | 44 | grains |
| 2. Water | 16 | ounces |
| Sodium sulphite (anhydrous) | 260 | grains |
| Sodium bisulphite | 1 | ounce |
| | 85 | grains |
| 3. Water | 16 | ounces |
| Sodium sulphite (anhydrous) | 260 | grains |
| Hydroquinone | 175 | grains |
| Pyro | 44 | grains |
| 4. Water | 16 | ounces |
| Sodium carbonate (desiccated) | 2½ | ounces |

Add enough water to make one gallon.

Mix each solution separately and pour into tank as mixed. Be sure to add them in the order given and in no case should the temperatures exceed 125° F. Be careful that this developer does not come into contact with bare iron or other metal. Use enameled trays. Develop for 12 minutes at a temperature of 65° F.

NOTE:—This developer does not require bromide as enough is given into the solution by the films or plates.

Special Developer for Bromide Paper.—

| | | |
|--|----|--------|
| Water (125° F.) | 24 | ounces |
| Sodium sulphite (anhydrous) | 4 | ounces |
| Di-aminophenol hydrochloride | 1¼ | ounces |
| Cold water to make | 32 | ounces |
| For use add 1 dram of a 10 per cent solution of potassium bromide to every 8 ounces of developer used. | | |

NOTE:—This developer will not keep. Only enough should be mixed for one day's work.

Develop for 15 minutes at a temperature of 65° F. when freshly mixed. Increase the length of developing time 1 minute each day. Remove scum from the surface and stir the tank each time before using. In the summer or rush

Deep Tank Developer for Roll Films (D-18).—

| | | | | | | | | |
|----------------------|----------------|--------|-----------------|---------|-----------------|---------|-----------------|---------|
| To make complete ... | 1 | gallon | 10 | gallons | 14 | gallons | 48 | gallons |
| Water | $\frac{1}{2}$ | gallon | 1 | gallon | 2 | gallons | 5 | gallons |
| Metol | 10 | grains | 100 | grains | 140 | grains | $1\frac{1}{4}$ | ounces |
| Sodium sulphite | $1\frac{1}{4}$ | ounces | $12\frac{1}{2}$ | ounces | $17\frac{1}{2}$ | ounces | 60 | ounces |
| Sodium bisulphite .. | 15 | grains | 150 | grains | $\frac{1}{2}$ | ounce | $1\frac{1}{4}$ | ounces |
| Hydroquinone | 40 | grains | 1 | ounce | $1\frac{1}{4}$ | ounces | $4\frac{1}{2}$ | ounces |
| Sodium carbonate .. | 300 | grains | $6\frac{3}{4}$ | ounces | $9\frac{1}{2}$ | ounces | $32\frac{1}{2}$ | ounces |
| Pyro | 100 | grains | $2\frac{1}{4}$ | ounces | $3\frac{1}{4}$ | ounces | 11 | ounces |
| Potassium bromide .. | 6 | grains | 60 | grains | 85 | grains | 290 | grains |
| Water to make | 1 | gallon | 10 | gallons | 14 | gallons | 48 | gallons |

season for photo finishing the amount of potassium bromide in the developer may be reduced to three-fourths the amounts given above. For increased brilliancy add glycerine to the developer in the proportion of one ounce to fourteen gallons of solution.

Rotogravure Tone Developer.—For chocolate colored pictures without toning.

| | | |
|------------------------|-----|--------|
| Water | 72 | ounces |
| Sodium sulphite | 6 | ounces |
| Potassium carbonate .. | 10 | ounces |
| Glycin | 850 | grains |
| Hydroquinone | 265 | grains |
| Potassium bromide | 125 | grains |

For use, take 1 part of the developer to $7\frac{1}{2}$ parts of water. This formula is now being widely used by photofinishers for new effects. During the last year many professional finishers have installed separate tanks to give their customers colored prints. This developer gives a sepia without toning.

TONING PICTURES FOR DOUBLE COLOR

The cost of producing toned, colored pictures has been so low that it is now done on a commercial basis and is coming increasingly into demand. Three tanks are usually installed, one for Red, one for Blue, and one for Green. The red is used for toning landscapes, interiors, sunsets, fires, etc. The blue is used for ocean, lake, and moonlight scenes. The green is for landscapes, flowers, trees, and scenery. The names of the

colors are placed on the vats to enable the employees to sort the pictures out quickly when removing the prints from the washing tanks. They are simply thrown into their respective vats and allowed to remain for a space of a couple of minutes, then removed and returned to the washing vats. After that they can be ferrotyped in the usual way.

One of the most important points in "toned" color pictures is that the "WHITES" of the pictures must not be effected or colored by the baths. Example: if a white ship or yacht with white sails is photographed, and then toned, the white sails and white boat must remain white and it is only the reduced silvers in the picture that should "take on the blue." The finished picture should come out with blue water, and white boat. Of course, all other black parts of the photoprint would take on the blue; but that is all right providing the other objects that are white remain white.

Same applies to Green. The trees and grass would take on the green, but the sky would remain white (unless of course a sky filter was used on the camera). But this is very rare with the average amateur camera fan; and even at that the clouds would be the only part of the sky affected. Some very beautiful effects have been obtained in keeping a cement road white, photo finishers will find great response to this class of new printing. The camera amateur will also find it very interesting to color up his album pictures without having to have any artists tuition.

The ordinary black and white photo print is just allowed to soak in a selected color bath for a couple of minutes and then the print is removed and washed well under running water until the "whites" are clear.

There is however one point to watch, and that must receive the most careful consideration. Never allow ammonia to be around the color baths as it will ruin them immediately. Always be sure the print is absolutely free from hypo, and keep all alkali away from the baths, as it will ruin the solutions very quickly.

Slightly acid water will tend to improve all the colors.

These colored prints, if ferrotyped, offer some very beautiful effects.

COLORED PICTURE BATHS:

Blue.—

| | |
|---------------------------|----------|
| Iron and ammonium citrate | |
| (green scales) | 5 ounces |
| Potassium ferricyanide .. | 5 ounces |
| Oxalic acid | 4 ounces |
| Water | 1 gallon |

Allow the prints to remain in this solution for at least three to four minutes and then wash in running water for at least 12 minutes.

Red.—

| | |
|---------------------------|-----------|
| Water | 70 ounces |
| Uranium nitrate | 2 ounces |
| Potassium ferricyanide .. | 2 ounces |
| Oxalic acid | 1½ ounces |

Allow the prints to remain in this bath for at least four or five minutes, then remove and wash well in still water for 15 minutes. A quick rinse in ammonium chloride will clear the whites on both the blue and the red.

Green.—Many formulas but very few have been successful, which is proven by the fact that one sees very few green tone prints. The writer has tried out many formulas and the one given below was discovered after months of research work.

| | |
|---------------------------|----------|
| Take hot water..... | 8 ounces |
| 2 drams hydrochloric acid | |
| ¼ ounce vanadium chloride | |

Mix these well together and place the mixture on an electric stove. Heat gently until the vanadium is thoroughly dissolved.

Make a solution of oxalic acid by dissolving 2 ounces of oxalic acid in 12 ounces of water. Add to this 15 grains iron chloride and 2 drams of sulphuric acid.

If the greens are not desirable, add more vanadium chloride.

Allow the print to remain in this solution for at least 5 to 8 minutes. Remove and wash well in running water until the whites are clear. Make only sufficient of the Blue, Red, and Green to last one day, as their life is short and after that they will stain the whites. Bromide enlargements can also be treated in these color toning baths. For those who wish to get the richest tones possible with bromide enlargements here is a tone color that gives colors ranging from rich brown to purple black

| | |
|-----------------|---------------------|
| Lead nitrate .. | ½ dram dissolved in |
| water | ½ ounce |

Dissolve in 1 ounce of water and one dram of alum.

Now dissolve 1 ounce ordinary hypo in three ounces water.

1 grain Gold chloride in ½ ounce of water.

Dissolve separately, and add together in the rotation given above. The solution will be clear.

DOUBLE TONING (Dual Sepia):

Here is a toner that will give two shades of different browns in the one picture, and the effect is very pleasing.

Make a solution of ½ ounce chromic acid in 10 ounces water. Place the print in this solution until it nearly fades out (about a minute or so). Wash the print in running water and then place the print in ordinary film developer (M.Q.) and redevelop back to visibility.

This formula takes the place of the old time sulphide print for rich browns. Unlike the old time sulphide process the above is odorless and less liable to produce insoluble stains.

Here is a formula that is being widely used by professional studios that specialize in photos of live stock, as it produces a "Natural Brown" picture that gives an effect nearer the natural color of the animals.

Take one ounce of bichloride of mercury (poison) and dissolve in 16 ounces of warm water.

Allow the prints to remain in this solution for five minutes. Then wash well, and immerse in a solution 1 ounce hypo and 5 ounces of water, with ½ dram added of ordinary household ammonia. Leave print in this solution until the desired shade is reached, then remove and wash well in running water.

For the amateur who does not care about investing in a supply of poison

chemicals for toning in a small way, can purchase from his local dealer a complete set of an assortment of 10 Lero-toners in a box for a very small outlay.

TWO COLOR PRINTS:

Photo prints that have been "overlapped" with two different colored toners, and rendered glossy with a simple ferrotype plate, produce pleasing effects. The advantage of "local color toning" is that one does not require any tuition. Take for instance a photo of a church with a tall steeple. One can simply take the red toning bath (as previously given) and apply it over the church with a piece of cotton. There is no need to try and keep "within the lines" because the toner will not effect the "light" parts of the picture. Allow the picture to remain on the table (face up) for 5 minutes, then rinse in water and immerse the entire print in the blue toning bath. After a lapse of five minutes the picture is removed from the blue toning bath, and washed well in running water for about 15 minutes. The finished picture will be a dark reddish brown church with a blue sky. This process, perhaps, presents a more natural effect than if the photo print was colored by an artist. Toned pictures should always be placed on a ferrotype plate.

FERROTYPE PLATES OR TINS:

These tins certainly do produce a gloss on photo prints that is impossible to obtain with the uses of varnishes, etc.

The plates are very easily made if a good grade of enamel is used (your local hardware merchant can supply many nationally advertised brands that dry with a high lustre).

Purchase some sheets of heavy tin, clean well with gasoline and wash in soap and warm water, rinse and allow to dry.

After painting the sheets, take hold of the sheet and tap it with the finger until you see the "brush marks" disappear.

Place them somewhere free from dust to dry.

After the plates are dry they need to have a coat of Squeegee enamel which is made as follows.

SQUEEGEE ENAMEL:

| | |
|------------|----------|
| Turpentine | 1 gallon |
| Naptha | 1 gallon |
| Bees wax | 7 ounces |

Take half the turpentine, place the broken up bees wax into this, place on an electric stove and allow to get hot (stirring occasionally).

Add the remaining part of the turpentine, and then add the naptha. Bottle this up, and keep well corked. Care should be taken in mixing this solution as it is highly inflammable and should never be used near an open flame. Pour a little of this on the painted tin (the ferrotype tin) and with a piece of cloth spread all over the plate. Wait a few minutes until dry and then polish well with piece of flannel. The plate is now ready to receive prints for glazing.

The action of this ferrotype or glazing tin in producing the gloss on photo prints is this:

When the washed print is drained of its surplus water, it is placed on the tin, and a piece of blotting paper laid on it. A small rubber squeegee roller is then run over the back of the print. The action of the squeegee roller forces the gelatine in the emulsion that is on the print, outwards. The forced out gelatine is forced up against the polished ferrotype tin, and, that being as far as it can go, a layer of shiny gelatine is thus formed on the surface of the print as it lies face down on the ferrotype plate.

When the photo print is dry, it is peeled off the plate and the result is a photo print of high lustre.

Do not forget to polish the ferrotype plate with dry clean cloth each time before you put prints on it to glaze.

If the prints are hard to get off, it is caused by the emulsion on the prints being too soft. (This can be remedied by the addition of a little alum in the hypo.) (See Fixation.)

PANCHROMATIC DESENSITIZING DEVELOPERS. (Color gradation):

The introduction in late years of the panchromatic plate has found great favor in the photographic field. The true meaning of the name "Panchromatic" is "the true rendering of all colors in their various gradations." This does not mean that a panchromatic plate or film in your camera will give you a photograph in natural colors. It will not do this, but it will give you a black and white reproduction of more even tone and more illumination in red and yellow objects than has been done with ordinary plates which were insensitive to red light to a large extent. Pan-

chromatic film is just as sensitive to blue and violet light as an ordinary plate, but in addition, it is also sensitive to orange and red. Yellow or orange colored objects photographed on ordinary plates yield dark images, while blue objects of almost any shade, although some of them may appear dark blue to the naked eye, will reproduce nearly white. It has been found that the particles of silver halide are most sensitive to those colors which they absorb, and numerous experiments have been undertaken to find a substance which would enable the silver salts to absorb the whole of the rays in the same ratio as we see them. But this has proved so far to be impossible and although means have been discovered to render the silver salts more sensitive to the less refrangible rays of the red and yellow, which are most luminous to the naked eye, yet they still remain most sensitive to the blue rays. These colors are toned down or robbed of some of their actinic value by being filtered through color filters; but unfortunately, the total sensitiveness of the whole plate is lowered in consequence.

The ordinary, or non-orthochromatized, plate is extremely sensitive to blue and violet light, so much so that any object of very blue intense color photographs also like white. Violet also, so long as it is a true violet and free from red, photographs far lighter than it appears to the eye. Green, on the other hand, appears much too dark in a photograph, while pure yellow, and still more pure red, appears practically as dark as a jet black. To take a very common example: an orange placed on the customary greyish black focussing cloth, and photographed on an ordinary plate, appears in print almost as dark as the cloth itself, and yet to the eye, the fruit stands out as a brilliant highlight. This is an exceptional instance, the skin of an orange being of a particularly pure color. The great majority of the colors in nature are far from pure, but when analysed show themselves to be subtle, compounds made up of many tints, some of them quite unsuspected. Then again, most natural objects have a surface which reflects a great deal of white light, foliage being a case in point, and this white light will affect the emulsion, even if the object from which it is reflected is of a color to which it is insensitive. It is for this reason and many others that the panchromatic plate has been introduced.

Highly colored flowers and insects are often impossible to photograph without panchromatic plates or films, as of course are paintings and many other artificial creations.

Panchromatic plates and films are manufactured by a great number of plate manufacturers to overcome this trouble of difference in color gradations.

Now these particular plates or films should be developed in total darkness or else under the glow of a very faint GREEN light.

This has been one disadvantage that the present day camera amateur and professional have not been able to get acquainted with.

Chemistry has again come to their assistance and produced a developer that is termed as the panchromatic desensitizing developer.

The PINACRYPTOL family has been assembled by the chemists to assist us to develop these important plates in a more convenient manner. Let us first take the mother of all desensitizers, Pinacryptol GREEN. It is the most efficient desensitizer dye that has yet been discovered, brilliant greenish black crystals, soluble in water, giving a non-staining solution, which may be made in one to 500 strength for storage. In addition to its non staining qualities it acts more efficiently in one in 5000, solution, as a desensitizer than phenosafranine, especially with panchromatic plates. Its action is quite different, since prolonged washing has far less power to reduce the desensitized condition, when this desensitizer has been used. May be used likewise as a preliminary bath, or as an addition to the developer.

The method of adding the desensitizer (pinacryptol green) to the developer has found more favor than the preliminary bath method.

For very highly sensitive color plates, the green is advised, preceded by a preliminary immersion in a solution of pinacryptol yellow. Like pheno-safranine, this desensitizer converts hydroquinone into a quick-acting developer. It markedly retards the action of amidol as a developing agent, but does not influence M.Q. or Pyro.

Panchromatic plates are made sensitive to the colors of the entire spectrum and therefore great care has to be exercised in developing the latent image into visibility.

The feeble green light required for developing panchromatic plates without a

desensitizer in the developer, is so feeble that just as many plates have been spoiled by the accidents in darkness as those that have been light-struck.

When you add a desensitizer to your developer, you simply place the plate or film in the developer under a very feeble light. BUT AFTER A LAPSE OF TWO MINUTES or even less you can then finish the developing under a bright red light or even an orange light with perfect safety.

Some developers allow the direct addition of the pinacryptol green solution to the developer. In this case we recommend the use of a rodinal developer. Also diluted glycine developer permits the addition of the green solution. But hydroquinone and all developers containing more than 15½ grains of hydroquinone in 34 fluid ounces are not suitable, for they do not permit the addition of the pinacryptol green.

DESENSITIZER DEVELOPER SOLUTIONS:

To every 3½ ounces of the diluted developer add 85 drops of the pinacryptol green 1 in 500 solution. Developing should be started in total darkness or under a very feeble green light, and after 2 minutes the bright red or orange light can be turned on and thus the development can be finished with ease in the light.

Do not use pinacryptol green on color plates, pinacryptol yellow must be used.

The trouble in altering the brand of developer in order to use the pinacryptol green can be overcome by the use of safranine (1 part in 2,000 parts of water). The chief objection to this desensitizing agent is that it has been giving trouble by staining the plates and films. Here is a formula and method that will overcome that trouble and allow the use of the ordinary developer.

1. Pheno-safranine
(water soluble) 20 grains
Water 8 ounces
2. Formaline (37%
solution) ¼ ounce
Sodium sulphate (dry) 1 ounce
Water to make 9 ounces

Directions: Add one ounce of (1) solution to nine ounces of solution number 2. The plates or films are bathed in this solution for two minutes. They are then rinsed and are ready for development. This solution keeps well and hardens the film in hot weather.

NOTE:—Should you have trouble in a stain by the use of safranine in any other process this can be removed by diazotisation with a solution containing 1 cc. of a 10 per cent solution of sodium nitrite, and 1 cc. of a 30 per cent solution of hydrochloric acid per 100 c.c.s.

THE CHEMISTRY OF INTENSIFICATION AND REDUCTION

REDUCTION:

The term "reduction" as commonly used in photography means the weakening of a negative, which because of over-exposure or over-development contains an image that is too dense. Too much silver metal exists in the image, making the negative appear flat, foggy and without contrast in the case of over-exposure, and too contrasty in the case of over-development.

To adjust such negatives for normal and satisfactory printing, some of the silver image must be gradually removed without injuring the negative. The silver metal of the image, however, resists the solvent action of all reagents except those which also destroy the gelatin. Therefore, it is necessary to first convert part of the image into some soluble silver salt which can be easily washed away with water or some other suitable solvent.

This conversion of part of the silver image into a soluble silver salt is accomplished with certain oxidizing agents which gradually react, forming compounds such as silver ferrocyanide, silver chloride, etc., which are easily dissolved and washed away, leaving only the desired amount of silver metal in the image. The ease and rate of conversion vary with different oxidizing agents. Some attack the weaker or shadow parts of the silver image first, whereas others oxidize the denser parts before reacting with the shadow details. This difference in action is very desirable since it permits the choice of a chemical most satisfactory for a particular negative trouble.

Formula.—

Mix 3½ ounces of 10% solution hypo
75-150 minims of 10% solution potassium ferricyanide

It is better to use less potassium ferricyanide and to stop the action before desired result is obtained as too much contrast may result through excessive loss of detail.

Formula.—For negatives which are too dense all over, and lack contrast, due to over-exposure and over-development, use the following:

| <i>Solution A</i> | | |
|-------------------|-----------------|-----------------------|
| Water | 16 ounces | 480 cubic centimeters |
| Hypo | 1 ounce | 30 grams |

| <i>Solution B</i> | | |
|------------------------|-----------------|-----------------------|
| Water | 16 ounces | 480 cubic centimeters |
| Potassium ferricinnide | 1 ounce | 30 grams |

As this B solution is affected by the light, the bottle containing it should be of amber color or wrapped in opaque paper and kept in the dark when not in use.

Mix for immediate use:

| | |
|------------|----------------|
| Solution A | 8 ounces |
| Solution B | 1 ounce |

The negative can be placed in the solution directly after fixing. If a dry negative is to be reduced, it must be soaked in water for a few minutes before applying the reducer. To avoid streaks, always rinse the negative before holding it up for examination. As soon as sufficiently reduced wash thoroughly. This reducer increases contrast in the negative.

Formula No. 1.—

| <i>Solution A</i> | | |
|------------------------|-------|-----------|
| Water | | 1 ounce |
| Potassium ferricyanide | | 15 grains |

| <i>Solution B</i> | | |
|-------------------|-------|-----------|
| Water | | 32 ounces |
| Hypo | | 1 ounce |

Add "A" solution to "B" and immerse negative, watching the action of the reducer carefully. The reducing action can be observed best when a white tray is used. Wash negative thoroughly after reduction.

The above solution will not keep in combination. Mix fresh solution for each occasion.

Formula R-4a—For all Professional Films and Plates.—

| <i>Stock Solution A</i> | | |
|-------------------------|--------------------|-------------------------|
| | <i>Avoirdupois</i> | <i>Metric</i> |
| Potassium ferricyanide | 1 1/4 ounces | 37.5 grams |
| Water to make | 16 ounces | 500.0 cubic centimeters |

| <i>Stock Solution B</i> | | |
|-------------------------|-----------------|-------------|
| Hypo | 16 ounces | 480.0 grams |
| Water to make | 64 ounces | 2.0 liters |

For use take: Stock Solution A, 1 ounce (80 cubic centimeters), Stock Solution B, 4 ounces (120 cubic centimeters), and water to make 32 ounces (1 liter).

Pour the mixed solution at once over the negative to be reduced. Watch closely. The action is best seen when the solution is poured over the negative in a white tray. When the negative has been reduced sufficiently, wash thoroughly before drying.

Solutions A and B should not be combined until they are to be used. They will not keep long in combination.

Formula.—

| <i>Solution A</i> | | |
|------------------------|-------|-----------|
| Potassium ferricyanide | .. | 1 ounce |
| Water | | 16 ounces |

| <i>Solution B</i> | | |
|-------------------|-------|-----------|
| Hypo | | 1 ounce |
| Water | | 16 ounces |

Dissolve ferricyanide in dark bottle, or wrap bottle in opaque paper, as it is affected by light. Reduction should be carried on in subdued light never by strong daylight.

Take a sufficient quantity of B to cover the negative in a tray and add a small quantity of A. Then immerse the negative. Remove several times during the operation and wash off the chemicals, preventing the negative from staining. Wash thoroughly after desired reduction has been obtained.

INTENSIFICATION:

It sometimes happens that a negative does not produce good prints because it is too weak, too dense, too flat, or too contrasty. If a new exposure is impossible some of these faults can be partially modified and, in some cases, almost completely corrected by the processes known as "intensification" and "reduction."

If the negative is too thin, it contains too little silver metal in the image and can be strengthened by intensification. If the negative is too dense, it contains too much silver metal in the image and can be weakened by reduction. Sometimes, a faulty negative requires a combination of these processes. For example, if a negative is over-exposed the image is too dense with normal development and will require reduction only. On the other hand, if the same negative is under-developed the shadow details are not distinct and it requires intensification.

INTENSIFICATION PROCESSES:

Mercury Type and Formulas.—Intensifying with mercury salts imparts different degrees of increased opacity to the image and manufacturers of plates and films commonly include formulas giving satisfactory results.

Finely divided mercury metal is more opaque than finely divided silver metal. It more completely absorbs all wavelengths of light, imparting an intense black color by replacing part of all of the silver metal in the image.

Most mercury salts are insoluble, but mercuric chloride (corrosive sublimate) is sufficiently soluble for use in a bath in which the well washed negative is placed. (In all except one of the following methods, all traces of hypo must be eliminated by thorough washing to prevent irremovable stains.) The mercuric chloride in solution is broken down by the finely divided silver metal in the image (which in this form is a good reducing agent) to mercurous chloride. Simultaneously the silver metal is converted (oxidized) into silver chloride as follows:

Silver and mercuric chloride is
(forming image)
silver chloride and mercurous chloride
(forming image) (forming image)

Thus the original image formed by silver metal is changed to a mixture of silver chloride and mercurous chloride. Both are white insoluble substances so that the negative appears free from any dark silver metal when viewed from the back by transmitted light. The completion of this first step is therefore indicated by the disappearance of the image. For this reason the mercuric chloride bath is called a "bleach."

Most formulas recommend adding a small quantity of one of the following chemicals: sodium chloride, ammonium chloride, hydrochloric acid, or potassium bromide. These substances in the order named increase the amount of mercuric chloride which may be dissolved in a unit of solution.

When bleaching is complete the negative is washed in a dilute solution of hydrochloric acid to eliminate any excess mercuric chloride left in the gelatin. Washing in water removes most of it but by increasing the solubility, as stated above, all of it is removed with the aid of hydrochloric acid, preventing future stains.

BLACKENING THE BLEACHED NEGATIVE:

After bleaching and washing in the dilute hydrochloric acid bath, the negative is ready for the final step of breaking down the silver chloride and mercurous chloride now forming the image. There are many ways to do this but the following represent those most commonly used to convert the bleached image into mercury metal, silver metal, or some complex mercury silver compound giving an intense black color. These solutions are called "blackeners." The chemical action of the various kinds of blackeners follow:

SODIUM SULPHITE ANHYDROUS:

A slight increase in density is obtained by placing the negative in a solution of sodium sulphite. This is a good blackener which converts (reduces chemically) the mercurous chloride to finely divided mercury metal and possibly a complex mercury salt. The silver chloride is changed (reduced chemically) to silver metal but about half of the silver is lost due to solvent action which the sodium sulphite exerts, particularly in the shadow portions. For negatives that are originally too weak in the shadows for successful printing, this solvent action is disastrous, and some other blackener should be used.

The negative is thoroughly washed after intensifying to eliminate traces of sodium sulphite to stop further action.

Formula.—Prepare the following solution which will keep indefinitely:

No. 1

Water 16 ounces 500 cubic centimeters

Mercuric chloride .. ¼ ounce 8 grams
Potassium bromide .. ¼ ounce 8 grams

No. 2

No. 2 should be freshly mixed
Water 8 ounces 250 cubic centimeters

Sodium sulphite anhydrous . 1 ounce 30 grams
(which will test 60° by hydrometer)

After the negative is well fixed and washed, immerse in No. 1 until it has become thoroughly whitened, and after rinsing carefully place it in No. 2, leaving it there until entirely cleared. If sufficient intensification has not been

gained, wash for ten minutes repeat the operation and finally wash well. If after intensification the negative is too dense it may be reduced by placing it for a few seconds in water 16 ounces, hypo 1 ounce.

If the negative has not been thoroughly fixed and washed before intensification, stains will ensue.

Formula.—

Mercuric chloride .. 150 grains
Potassium bromide . 150 grains
Water to make 16 ounces

Before placing the negative in above intensifying solution, wash thoroughly. Plate remains in this bath until the image has turned white all over. It is then rinsed and immersed in a solution of sodium sulphite and water, one part sulphite to eight parts water, in which it slowly and evenly darkens. It is then washed thoroughly to remove the sulphite.

Formula IN-L.—For professional films bleach the negative in the following solution until it is white, then wash thoroughly:

Potassium
bromide $\frac{3}{4}$ ounce 22.5 grams
Mercuric
chloride $\frac{3}{4}$ ounce 22.5 grams
Water to make..32 ounces 1 liter

The negative can be blackened with 10 per cent sulphite solution, developing solution such as Formula D-61 a diluted 1 to 1, or 10 per cent ammonia, these giving progressively greater density in the order given. To increase contrast greatly without increasing the density in the shadow portions blacken in:

Sodium or
potassium
cyanide $\frac{1}{2}$ ounce 15 grams
Silver nitrate ... $\frac{3}{4}$ ounce 22.5 grams
Water to make..32 ounces 1 liter

In order to make this up, dissolve the cyanide and silver nitrate separately, and add the latter to the former, until a permanent precipitate is just produced; allow the mixture to stand a short time and then filter. This is called Monckhoven's Intensifier.

Formula.—

Solution No. 1

Mercuric chloride .. 200 grains
Potassium bromide . 100 grains
Water 10 ounces

Solution No. 2

Sodium sulphite
anhydrous $\frac{1}{2}$ ounce
Water 4 ounces

The negative must be well fixed and washed before intensifying.

Place negative in No. 1 rocking gently, until completely bleached. Wash in running water for at least half hour—success of the after-treatment depends upon this washing—then place in No. 2 until bleaching entirely disappears. Wash for fifteen minutes in running water.

PHOTOGRAPHIC FIXATION

FIXATION:

Fixing the negative means just what it says. It "fixes" the image and prevents the white parts from blackening and destroying the semblance of a picture. After the development the unreduced silver salts are removed by the action of the fixing bath that is made up of a solution of sodium thiosulphate, commonly known as hypo.

No part of the image is affected by the hypo unless the prints are forgotten and allowed to remain in the solution too long, especially if the prints are floating face up. It is best to put prints into hypo face down and not leave them in the solution longer than twenty minutes. Unless the hypo solution is nearly exhausted, the fixing time should never exceed fifteen minutes.

There are only a few substances that will dissolve silver halides and hypo is the most used one commercially, because of its low cost and its safety in use. When emulsions first came into general use years ago, potassium cyanide was used as the fixing salt, but since it is a dangerous poison it is never used today. In the process of fixation, the silver halide is dissolved in the hypo by combining with it to form silver thiosulphate which is immediately changed over into on or more complex salts of silver and sodium thiosulphate that are soluble in water. As long as the fixing bath has any appreciable fixing power the soluble salts are thus formed and proper fixing action takes place.

The developing solution completes the reduction of the silver salts that had been started by the action of light. The principal action of the fixing bath is to remove all of the unreduced silver salts. Silver compounds not acted on by light or the developing solution are readily soluble in hypo. This chemical is, therefore, the most important ingredient in the fixing bath.

A plain, fresh solution of hypo works well in cool weather, but does not remain efficient very long. After a short time the reaction of the chemicals brought over from the developing bath into the hypo solution stains the prints and negatives that are fixed in it, therefore, some preservative must be added to the hypo fixing bath, which we will discuss shortly.

As a developing solution agent does not act or reduce silver salts except in an alkaline condition, and as the purpose of the fixing bath must be the opposite, it must be acid. This is generally accomplished by adding acetic acid. Acetic acid, however, turns hypo milky. The hypo decomposes into free sulphur and sodium sulphite. Fortunately, this chemical action is reversible, since a solution of sulphur and sodium sulphite combine to form sodium hyposulphite again upon boiling. This being the case, an excess of sodium sulphite is maintained in the fixing bath to oppose the decomposition of the hypo by the acid. In this way it is possible to add sufficient acid to the fixing bath to neutralize the alkali that is carried from the developer on the print or negative into the fixing bath and to prevent it from decomposing the hypo.

The excess of the sodium sulphite also prevents the oxidation of the developing agents that are also carried into the fixing bath, it acts as a preserver by absorbing the oxygen dissolved in the solution from the air before it react with the developers to form stain.

All possible sources of trouble in the fixing baths are thus far taken care of, excepting the softening of the gelatine of which the emulsions on prints and negatives are composed. Some substance has therefore to be added to the fixing bath in order to take care of this, otherwise, negatives would be ruined by frilling and peeling off and they would be so soft that they would be impossible to handle.

Potassium chrome alum, therefore, enters into the field of trouble-preventing and produces such a hardening effect on the emulsion that the present day fixing bath offers little or no trouble to the photographers. Plain potassium alum, while not quite such an efficient hardener, is often used instead of the chrome alum and is especially good for prints as it does not give a stain of any sort.

A worn out fixing bath causes more trouble than one cares to entertain. Such as stained prints, fading of prints, and a host of other troubles, so there-

fore, we have prepared a short trouble chart on fixation that will enable you to look and find what is the cause of your troubles. The formulas given in this book have been carefully tested, but other troubles apart from mixing the chemicals may take place according to the conditions under which you are working.

STAINING OF PRINTS:

Insufficient Sulphite.—If this is the cause there is no preservative to prevent oxygen from the air decomposing the developing agent brought over from the developing solution. An oxidized developer turns the solution brown, staining the prints. Too little sulphite will also cause the fixing bath to turn milky.

Insufficient Washing of Negatives and Prints.—Washing eliminates most of the developer and alkali brought over from the developing solution. This washing prolongs the life of the fixer by conserving the acid and the sulphite which are the enemies of stain.

Scum on the Surface of the Bath.—This contamination attaches itself to the surfaces of the emulsions, prevents proper fixing, and is generally due to impure chemicals, dirt or dust in the trays, or it may be due to minerals dissolved in the water making it hard.

The formation of sludge in hypo baths has been a troublesome thing for many years, but it has been remedied just a few months ago, by the addition of boric acid crystals to every gallon of fixer. This sludge is a scum of aluminum sulphite and unless removed by careful swabbing with absorbent cotton or a camel's hair brush it causes trouble. If allowed to dry on the negative once, it is practically impossible to remove.

IF THE BATH DOES NOT HARDEN:

Insufficient Hardener in the Fixer.—Not enough alum in the solution or it has displaced the sodium in the sulphite and is, therefore, inactive. The hardening of gelatin is called tanning and may be accomplished by potassium alum, chrome alum, tannic acid, or formalin.

IMPROPER MIXING:

As free acid decomposes hypo into free sulphur, the two cannot be mixed together when preparing the solution. Sulphite prevents this reaction, and so sulphite and acid are mixed and alum is then added. After the acid hardening

solution is prepared, it is cooled to room temperature before adding it to the cold hypo solution.

It is important when preparing an acid hardening solution not to mix the sulphite and alum before adding the acid. In the absence of acid, alum and sulphite react forming aluminum sulphite, which will precipitate in the form of a white sludge.

If a fixing bath formula includes sodium metabisulphite or sodium bisulphite (acid sulphite) instead of sodium sulphite and acetic acid, it is very important to prepare the acid hardening solution separate from the hypo solution, and add the two together after they have cooled to normal temperature and not over 85° F. At a temperature of over 85° F. the acid in the fixing bath becomes more active and acts as if it was in excess (or more than what is required) and it decomposes the hypo into free sulphur and the solution is worthless and has to be thrown away. New formulas for fixing baths that will not throw down a sludge are as follows:

| | |
|---------------------------------|-----------|
| I.—Water (about 125°) | 80 ounces |
| Hypo | 2 pounds |
| Sodium sulphite (des) | 2 ounces |
| Acetic acid (28 per cent) | 6 ounces |
| Boric acid crystals .. | 1 ounce |
| Potassium alum | 2 ounces |
| Cold water to make one gallon. | |

Dissolve the hypo in the water and then add each chemical in the rotation given above and be sure that each chemical is dissolved before attempting to add the next one.

This fixer is not for papers, it is for films ONLY and will fix about 75 rolls.

| | |
|---------------------------------|------------|
| II.—Hypo | 3½ pounds |
| Water | 150 ounces |
| Sodium sulphite ... | 3½ ounces |
| Water | 28 ounces |
| Mix separately. | |
| Chromé alum | 3 ounces |
| Water | 42 ounces |
| Acetic acid (28 per cent) | 8 ounces |

Mix the first solution to the second one slowly stirring all the time.

Short Formulas.—These formulas are intended for those who have "run out" of hypo and need some quickly.

| | |
|---|-----------|
| III.—Hypo | 8 ounces |
| Water | 80 ounces |
| 1 ounce meta bisulphite. | |
| ¼ ounce alum and a dash of acetic acid. | |

The simplest thing to remember about fixing baths is ONE in FOUR, one ounce hypo to four ounces water.

Adding potassium iodide to the fixing bath results in softer and warmer tones.

Nitrate of silver and salt (½ ounce of each), salt first and then the silver intensifies the prints and negatives and gives bluish tones. Nitrate of silver and potassium iodide (iodide first) gives great contrast and warmer tones.

Alum and acetic acid gives no effect on tones, only tends to turn bath a slight purplish tone. Sodium chloride increases softness. Ammonium chloride increases action of hypo 40 per cent.

SHORT STOPS:

When negative or print is developed, it is washed and transferred to the hypo (fixer). But it sometimes happens that during the time elapsed between these operations development continues to take place and the results are that perhaps overdevelopment takes place. In between these two operations (the developing and fixing) another bath can be added and that is one that is called the "short stop." This bath consists of 82 ounces of water in which is added 1 ounce of acetic acid, glacial. This short stop bath also prevents streaks when prints are immersed into the fixing bath.

STAINS ON THE HANDS:

After a day's work, it is very hard to determine just what caused the stains on your hands since you have been handling so many chemicals. Nitrate of silver stains the fingers badly and the quickest way to remove these stains is to paint the fingers with iodine, allow to dry for a few minutes, and then wash your hands in your hypo solution. This removes the silver stains and the iodine stains at the same time. Another method is to paint the fingers with potassium permanganate, allow to dry, and then wash in a solution of sodium bisulphite.

The cleaner, Clorox, that is sold in all grocery stores is a good stain remover when you do not know what caused them.

PRINTING PHOTOS ON FABRICS:

The printing of pictures on silks, satins, and various other fabrics, calls for a special sensitizer with special developers, and special fixers. The old time formulas consisting of ammonium citrate and silver nitrate, does not give the satisfaction demanded by the ama-

teur let alone filling the requirements of the professional photographer. This old method of fabric printing was unsatisfactory from many points of view. First a lot of trouble was experienced with the fixation; if the photo was fixed in plain hypo it meant that about 45 times out of 50 the picture would fade out, and if it was not fixed, it would blacken all over in a few hours.

By adding a small amount of sulphite to the hypo, it was found that the fixing bath performed in a more satisfactory manner. However, it did not improve the printing qualities. It did not produce black and white images and these seem to be the ones most desired. The old formula was discovered long before rayon and crepe de chine fabrics were made, and these materials are loaded with a metallic salt.

These metal loads are used by the manufacturers to give the cloth weight so that the material, when made into gowns, will "fall" around the shape of the lady for whom it was made. These metallic loadings are metal and when they come into contact with silver salts, they have the same action as light has on the silver, that is, reduction.

None of the many formulas that have been published were ever totally successful until last year, when a sensitizer was developed especially for this kind of work. It is sold in photographic supply stores in bottles ready to use under the name of Lerotype Sensitizer. This solution will produce pictures in black and white tones on all kinds of satins and silks without any danger of blackening all over and ruining the cloth. This process has opened up great possibilities in the commercial field for making colored pictures on satin for radio grills, silken banners for theatre advertising, cloth covered buttons and inserts for dress manufacturers, and many other things which call for novel photographic effects. Photographers are featuring handkerchiefs with the owner's picture printed on it and the photo is permanent and will not wash out. Photo-finishers are giving them away as premiums with their regular orders. The formula is of a very complex nature, and if you are not a qualified chemist, we advise to buy the bottled solution from a photo supply house rather than attempt to mix it yourself.

The following is a formula given by the laboratories that manufacture the Lerotype sensitizer and it is said to be a very satisfactory one:

| | | |
|------------------------|---------------|--------|
| A.—Water | 32 | ounces |
| Nitrate of silver | 8 | ounces |
| B.—Potassium bromide . | 10 | grains |
| Water | 8 | ounces |
| Gelatin, pure | $\frac{1}{2}$ | ounce |

Use distilled water in this formula. Soak the gelatine from twenty to thirty minutes. Heat "A" to 125° F., then add "B" and bring the two combined solutions to 125° F. while working under a dim red light. Allow the solution to remain on the stove for 30 minutes at a constant temperature that does not exceed 130° F. Higher temperatures spoil the mixture and render it worthless.

After 30 minutes, add the following:

| | | |
|--------------------|---------------|--------|
| Water | 15 | ounces |
| Uranium nitrate .. | 4 | ounces |
| Copper chloride .. | $\frac{1}{2}$ | ounce |
| Potassium iodide . | 80 | grains |
| Pure gelatin | $\frac{1}{2}$ | ounce |

Soak this mixture for thirty minutes while the first one is on the heat. Upon removal of the first solution from the heat, add the second one slowly, stirring constantly. Filter and pour into enameled trays set on ice so as to cool quickly.

When cooled, cut up the mixture into small pieces, place them in a muslin or coarse canvas bag, and twist the bag so that the pressure forces the mixture out in the form of tiny shreds through the meshes of the cloth. Wash these shreds in five changes of cool distilled water. Now melt the entire mass of shreds until it can be poured. Pour into black bottles and chill from 40 to 48 hours. The sensitizer is then ready for use. Caution: Great care must be exercised in making this sensitizer to insure that no metal comes into contact with the solution at any time, otherwise, it will be ruined. Glass stirring rods and perfect enamel pots and trays must be used.

TRANSFERRING PICTURES ON METAL, WOOD, LEATHER, GLASS:

This is done by using a transfer paper, or a paper with a strong and strippable emulsion. This paper can be made by using the above sensitizer on paper that has first been coated with an insoluble gelatin made by the following formula:

| | | |
|---------------|---------------|--------|
| Sugar | 75 | grams |
| Water | 10 | ounces |
| Gelatin | $\frac{1}{2}$ | ounce |

Soak the gelatin for twenty minutes and dissolve by heating. Select sheets of a good bond or ledger paper and coat

them with this gelatin solution. Dry in a place free from dust. If the gelatin is not visible on the surface, give a second coating and dry. Mix:

Water 32 ounces
 Chrome alum 2 ounces

Soak the coated sheets in the alum solution for 10 minutes, wash in plain water and dry again.

When dry, again coat the paper with the first gelatin solution twice, drying between each coat. This time do not put into the alum solution, but take the coated paper into the darkroom where it is to be coated with the sensitizer given above for printing photos on cloth. When the sensitizer is dry it is ready for printing.

Now we have three coatings on this paper, the first one acting merely as a coating for the paper, and the second one acting as an interlocking layer that will allow the emulsion or sensitive layer to be stripped from the paper. This interlocking layer will melt when the action of heat strikes the back of the picture, thus leaving the emulsion that carries the picture "free" for the paper backing to be stripped from it. (It is not the object of the writer to advertise any product mentioned in these pages, but for all of those who do not have the time and equipment necessary to make this paper, it is to be purchased under the trade name Lerotransfer Paper at most supply stores.)

The paper is printed either contact or by projection and can be developed with any formula given for films and bromide papers. It is washed and fixed in PLAIN HYPO. The hypo must not be acid or contain a hardener. The hypo solution is water and hypo, 1 ounce hypo to 4 ounces of water.

Any ordinary negative can be used to print and this picture can then be transferred from its paper backing to such articles as glass, cigarette cases, ladies' compacts, and leather goods, like wallets and billfolds; in fact, the makers claim that it will go on any surface. The print is placed on the object and pressed down well so that the emulsion adheres to the surface. Then hold the object over a heater or stove so that the heat strikes the back of the photo. After about 15 seconds, the under layer of gelatin softens so much that the paper may be stripped off easily, leaving the emulsion on the object used as a new support. After it has thoroughly dried, it can be coated with a waterproof varnish.

This paper can be used for transferring photos to rubber or the new synthetic rubber, now being used to make printing cuts. This synthetic rubber line-cut work is becoming widely used and the very fact of having the photo transferred on the surface eliminates the expense of an artist's work. The transferred picture on the rubber is black and if transferred to this new synthetic rubber which is itself black, the picture cannot be seen by the operator until it is reversed from black to white. This is very easily accomplished by flowing over it a solution of bichloride of mercury of 1 ounce mixed with 4 ounces of water and 10 drops of hydrochloric acid.

This converts the silvers over into mercurous chloride and they appear white on the black background of the rubber.

Nothing more is required other than to wash the rubber cut in water and allowing to dry, and the cut is ready for the engraver, with the complete picture already on it, for him. This transfer work is both very interesting and profitable. Pictures can be transferred to different colored papers and also metallic papers and some beautiful effects can be obtained.

COLORED PHOTOGRAPHY:

Great research work has been done in this branch of photography, and already some nice samples have been obtained on glass that is viewed by transmitted light, but so far, colored photography on paper has not yet arrived until this "stripping process" comes into vogue.

It is simply a matter of stripping one photo on another. The pictures are so thin by the Lerotransfer method (formula for making paper outlined previous) that it cannot even be "felt" by the fingers.

Three pictures are required of three different colors, Red, Blue, and Yellow. These are printed on transfer paper and are prepared in the usual way for stripping.

Now in photographing the subject selected, three filters have to be used and therefore three photos have to be taken.

This can be accomplished in one operation if one should take the trouble of building a camera to hold three plates.

The three plates are fitted at the back of the camera and each one has its own color filter fitted into the frame that the plate is inclosed into, before it is loaded into the camera. The color filter

that the "filter holder" contains is 4 inches away on the red filter, $3\frac{1}{2}$ inches on the yellow, and $3\frac{1}{4}$ inches away from the "blue" plate. The exposure takes about 11 minutes on F.8 lens wide open. (Experiment was on June 22nd, Chicago on a bright day.)

The plates are developed and printed on stripping paper and then the yellow filter plate is toned with orange toner. The red filter is toned red and the blue one blue.

Select a good quality piece of bristol board with a fine, smooth finish. Measure off the exact position where the photo is to be stripped, and in each corner place a needle (pierced from the back and held firmly in place with sealing wax). These four needles act as the registration guides.

After blotting off the surplus water from the prints, lay each print carefully and accurately on top of each other being careful that they do not slide. Force the three prints on the points of the four needles, seeing that they completely pierce the three prints. Now, take the first print (no particular order is necessary, though yellow is generally first) and slip it carefully over the needles into the registration holes you have previously made. When the print contacts the paper, run a small squeegee roller gently over the print (being careful not to touch the needle points with the roller lest the needles be forced out of alignment).

Hold the cardboard over a small electric stove (about 6 inches above) and when you see the edge of the print slightly contract, gently strip the paper from the emulsion, by tearing or cutting with a razor a slit so that the paper can be stripped from the print without lifting the paper back over the needles again.

Wait a few minutes until the emulsion is set or recovered itself from the heat, and then strip the next color in the same manner, and then proceed with the third. Note:— Many experimenters are getting beautiful and novel results from the use of just two colors such as blue and red, yellow and red, and yellow and blue.

After the pictures have been transferred on one another, they can be painted with a solution of $\frac{1}{2}$ ounce of formalin in 5 ounces of water. This hardens the pictures and they can then be varnished with ordinary negative varnish.

Painting cardboard or bristol board one half pink and one half blue and then stripping a landscape picture on it, yields effects that are admired by everyone to whom it is shown.

Mottled show cardboard and various artist's boards may be used as a base for transferring prints and yields some beautiful and unique effects.

THE MINIATURE CAMERA

How to Buy a Camera.—The popularity of the small camera has been fast gaining a great foothold due to the fact that it presents the same sales resistance as the big automobile does against the smaller one.

The larger automobile necessitates a large initial outlay and then followed by an expensive upkeep. And the same thing applies to the old-fashion large camera as against the new miniature camera.

It is true that the miniature camera produces only a small picture but it has the capabilities of being enlarged many many times its original negative size.

It has however, another important advantage, and that is the enormous speed that the lens of the miniature camera has, for instance it is possible to "snap" any fast moving action with perfect sharpness, and can photograph a motor car traveling at a terrific speed of 200 miles per hour and even an airplane traveling at a speed of 350 miles per hour.

To purchase a lens with this speed on a large camera, the cost would be more than \$1000.

We are, therefore, giving you some useful information regarding the miniature camera that will enable you to produce enlarged pictures with the same amount of sharpness and definition as a contact print from a larger camera.

Serious photographers who but a few years ago would have despised pocketable cameras (a 4x5 instrument was at one period regarded with disdain) are now working exclusively with cameras giving an original negative smaller than a postage stamp.

These workers include experienced practitioners in commercial, press, exploration, pictorial and exhibition photography, and their amazing and technically perfect photographs have fired the general run of "snapshooters," who are now realizing the possibilities and qualities of the miniature camera and are adopting it.